Jellyfish Husbandry Guide

Foreword

A whole range of species fall under the term 'jellyfish' or 'gelatinous zooplankton' as they are properly known. Even Cnidaria, which is the phylum that encompasses most types of jellyfish, only spend a small portion of their lives in the free floating medusa or jellyfish phase of their four stage life cycle. Most people will associate the name Cnidaria with corals which are closely related to Jellyfish. In fact we could consider Jellyfish as a single free floating coral polyp.

The term 'Jellyfish' can be misleading though, as they are far removed from their very distant and much more advanced fishy relatives, in most cases having only a rudimentary nervous system designed to perceive the presence of prey and light in the case of some photosynthetic species. They are in fact one of the oceans most basic yet beautiful life forms.

Perhaps the easiest way to think of the jellyfish lifecycle is like that of a flowering plant on land. You begin with the plant (or polyp in the ocean). The plant produces fertilized fruit as a way of spreading seeds as far as possible from the parent. The fruit is generally eaten by a bird or animal and transported far away, before being deposited onto the soil to hopefully grow into an adult plant itself.

Polyps, which can live for over 10 years, produce medusa/jellyfish (referred to as ephyra in their early stages) to achieve the same goal. Unlike fruit, female medusas are fertilized sexually by the sperm of male medusa as they travel through the oceans. They can travel upon ocean currents for up to a year before releasing planula, their equivalent of seeds. The planula then settle on the sea floor and develop into new polyp colonies to start the cycle all over again

Introduction to jellyfish

From the dark and high pressured deep sea, to shallow tropical lagoons, jellyfish are one of the most widely dispersed animals, well adapted to the various environments of the ocean. Only recently have we started to recognize jellyfish as a beautiful aquarium exhibit instead of just a dangerous stinging creature to be avoided at all costs. Now, jellyfish have become one of the most popular attractions in public aquariums, drawing huge crowds of fascinated onlookers.

Most jellyfish are technically plankton which is defined as *'creatures which are not capable of swimming against ocean currents'*. So no matter what the size (Lion's Mane jellyfish could be the longest animal in the ocean with tentacle growth up to 37 metres, and Nomura's jellyfish could weigh up to

150Kg), most jellyfish are plankton due to the fact they drift in the ocean current.

What is it about jellyfish that is so appealing to us?
Some are mesmerized by the light, producing a rainbow of colours as is passes through their translucent bodies. Others may be relaxed by the way they swim, gracefully pulsing through the water, trailed by an intricate array of delicate tentacles. Jellyfish were first found in the ancient ocean billions of years before humans were on the planet. Since then, they have been pulsing in a steady rhythm. This rhythm might help you relax and forget about your busy life, in fact there is viable research indicating that the human stress factor can indeed be reduced by watching jellyfish.

Jellyfish were generally considered a difficult animal to keep in captivity until recently, mainly due to their weak swimming ability and fragile body. Although keeping and breeding jellyfish has been common place for scientific institutions for many years, there has only been a few aquariums made available to home hobbyists specifically for jellyfish, but most of them could not meet the specific demands of the jellyfish due to common design flaws or lack of adequate filtration.

Cubic Aquarium Systems has now designed the most sophisticated jellyfish tank available to date which makes keeping jellyfish simple and easy, and brings a modern and mystical touch to your home or office space by combining all the features of a modern easy to maintain aquarium with the cutting edge practices employed by expert keepers.

Species and distribution

From cold to tropical and from coastal to pelagic, you are almost certain to come across jellyfish where ever you are in the ocean. Recently, jellyfish have been discovered to inhabit even the deep sea of the Arctic and Antarctic Oceans. There are even a few species which live in fresh water.

How many species of jellyfish are there in the world?
This question is yet to be answered. All so called 'jellyfish' are divided into two groups, cnidarians andctenophores. Cnidarians have specially developed cells which sting and inject toxic chemicals into their prey. Corals and sea anemones are also categorized into this group, and their body structure is very similar to those of jellyfish.

Well known species of jellyfish such as moon jellies (Aurelia sp.), sea nettles (Crysaora sp.) and blue blubbers (Catosylassp.) are all categorized in this group, and they are further categorized in a class called Scyphozoa. There are two more classes of Cnidarian jellyfish, Cubozoa and Hydrozoa.

Cubozoa are more commonly known as box jellies because of the shape of their bells. They are often harmful to human because of their strong poison. Chironex fleckeli, also known as the 'sea wasp', and is one of the most venomous creatures in the world. Jellyfish in this class are very good at swimming and are also known to have very developed photo receptors akin to what we would term as eyes.
Hydrozoa is the least developed class yet covers most species of jellyfish (approx. 2700 species). Jellyfish in this group, such as the Portuguese Man O' War (Physalia physalis), can also be very harmful to humans. In total, the number of jellyfish species which are categorized as Cnidarians number approximately 2920.

Ctenophores, more commonly known as comb jellies, are often called jellyfish but they are very different animal from cnidarians. The most distinctive feature of a ctenophore is the eight strips or 'combs'

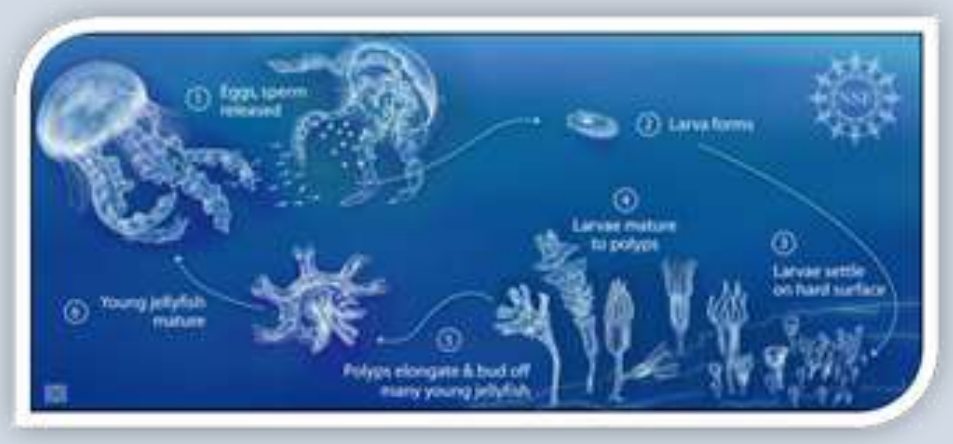
(groups of cilia) running along their transparent bodies. They swim slowly by waving these cilia which creates a spectacular display of rainbow colours as the light is reflected off them. Until now, there have been about 140 species of comb jellyfish recorded. However there are a lot more species to be found, as it has recently been discovered that there are a lot of comb jellyfish living in the deep oceans, previously inaccessible to scientists. These jellies are not harmful to humans as they do not possess either stinging cells, nor poison.

Body structure of the jellyfish

The basic body structure of cnidarian jellyfish is same as corals and sea anemones. Their body consists of two layers or bags (exoderm and gastroderm membranes), with a gelatinous structure filling the space between. The end with mouth is called the oral end, and the other end (the top of bell for jellyfish) is called the aboral or dorsal end. Whereas jellyfish medusa are usually found swimming with their aboral end in front, coral polyps and sea anemones attach their aboral end to the substrate and face their mouth (oral end) to the water. A number of feeding tentacles elongate from the edge of a jellyfish's bell, and the tentacles are covered in millions of tiny stinging sells called nematocysts. Jellyfish do not have a respiratory system, heart or brain. Oxygen diffuses through their bell membrane, and is circulated through the body by their pulsing movement. Jellyfish do not have eyes (except cubozoan jellyfish), but some do have sensory organs which tell them the brightness and the light balance.

The Life cycle of jellyfish

This is generalized life cycle of scyphozoan jellyfish (e.g. Aurelia) Scyphozoan jellyfish have four distinct stages to their life cycle.


1 Eggs, sperm released
2 Larva forms
3 Larvae settle on hard surface
4 Larvae mature to polyps
5 Polyps elongate & bud off many young jellyfish
6 Young jellyfish mature

1. **Planula**

Female jellyfish produces eggs and the males produce sperm which combine to produce a larva, called a 'planula' (plural = planulae). A planula is a tiny oval structure whose outer layer is lined with minute hairs called cilia. The cilia beat together to propel the planula through the water, but the motion of the cilia does not carry the planula far, instead ocean currents are responsible for transporting planulae long distances. The planula floats for a few days at the surface of the sea. It then drops downward to settle on a solid substrate where it attaches itself and begins its development into a flower like 'polyp'.

2. **Polyp (or scyphistoma)**

The planula metamorphoses to become sessile (i.e. fixed-position), usually benthic (i.e. bottom dwelling) polyp called a 'scyphistoma'. A scyphistoma has an anemone like body structure with a stalk attached to the substrate. At the top of the stalk there is a mouth surrounded by stinging tentacles which the polyp

uses to feed. The polyp feeds by using its stinging tentacles to catch microscopic organisms from the water column which it passes to its mouth for ingestion.

Polyps can multiply by producing buds or cysts that separate from the first polyp and develop into new polyps to form a colony also known as a polyp hydroid colony (or strobilating scyphistomata). Members of the polyp colony are linked together by feeding tubes. These colonies can live for years and each polyp is capable of producing thousands of jellyfish in its lifetime. When a polyp has built up enough stored energy from feeding and it feels the environmental conditions are right, the stalk like structure begins to develop into a larval stage (the strobila), which resembles a stack of saucers. One at a time, starting form the top, the saucers separate drifting off in the current to become 'ephyra'.

3. **Ephyra**

The process by which new medusae are produced is called 'strobilation' and involves metamorphosis of the end of a scyphistoma into an 'ephyra', an immature medusa that subsequently detaches and swims away. Depending on the species, a single polyp may produce one or many ephyrae all at once, over a period of time, or at different intervals.

4. **Medusa**

The ephyra subsequently develops into a mature medusa over a period of weeks to months. This is the stage most people recognize as a 'jellyfish'.

Water quality

General husbandry

Warning

Water quality should be tested regularly using test kits which are available at most local aquarium stores. It is good procedure to test your water quality every few days for at least two weeks after first adding jellyfish to ensure levels stay inside recommended parameters. Once it is established that the water parameters are stable you can reduce testing accordingly. Please refer to the 'problem solving' section if your water quality strays from recommended levels.

Temperature: 13-26^{o}C depending on species, try to adjust the temperature to match the area where from which they were collected.

For Aurelia species -commonly known as the Moon Jellyfish - a temperature between 16-20^{o}C is advised. In most situations this will coincide with the aquarium maintaining a temperature a degree or two below ambient room temperature thereby negating the need for any heating. Should temperatures climb above the desired range, the use of a chiller is advised using the connections supplied at the rear of the aquarium (refer to the aquarium user manual for more information).

Salinity: 34-35ppt although some jellyfish can tolerate a wide salinity range, it is generally still recommended to house them in water with a salinity close to that of natural seawater.

pH: 8.1 – 8.4

Other water parameters:

NH3 = 0.0 ppm	NO2 < 0.05 ppm	NO3 < 10.0 ppm
PO4 < 2.0 ppm	Alkalinity 7.4 - 8.4 DkH	

Note: Maintaining alkalinity by way of a suitable Alkalinity buffer will help stabilize pH between water changes. Phosphate (PO4) and Nitrate (NO3) are known contributors to increased algae populations. These should be monitored and maintained by way of regular partial water changes and if necessary in the case of heavy stocking or feeding, the additional use of relevant media's that can be added to the rear filtration chamber of the aquarium in a permeable media bag, or used in a remote power filter attached to the rear inlet and outlet ports provided.

Feeding

Important: The term Plankton and Planktivore used in this manual refers specifically to Zooplankton', i.e. animal planktonic organisms, and ***not*** phytoplankton (algal Planktonic organisms).

Most planktivore jellyfish need to be fed live baby brine shrimp (or frozen baby brine shrimp/ copepods/mysids). Try not to over feed, a general feed of once per day will be sufficient in most cases. It is good practice to remove as much uneaten food as possible from the aquarium when the jellies stomachs are full to ensure ongoing good water quality.

A good alternate if live or frozen food isn't available regularly, is 'Instant Baby Brine' manufactured by Ocean Nutrition which is available from reputable stores. This liquid food comes in a small tub with a measuring spoon making it easy to provide a daily measured amount of food.

An occasional feed with real live baby brine is however recommended and relished by most Jellyfish to maintain peak condition.

Jellyfish may also accept some types of dried planktonic or substitute dried planktonic foods such as Cubic Aquarium System's own. With particle size of 100 - 350 microns, this planktonic food for all jellyfish and filter feeding invertibrates offers a balanced feeding plan and meets the full nutritional requirements of most breeds.

Bowl method

This method is the most efficient and results in less pollution of the main aquarium water over time. Using a ladle, transfer all jellyfish from the aquarium to a bowl filled with seawater (from the aquarium). Feed jellyfish in the bowl until their stomachs are visually full (10-15 minutes). Transfer jellyfish back to the aquarium using the ladle, taking care to avoid transferring any uneaten food back into the aquarium. It is also important to note that the jellyfish, at no time, should be taken out of the water as this can cause damage to its delicate tissues. With this method, you lose a bit of seawater each feeding because you leave a percentage behind in the bowl. It is recommended to have some seawater prepared to replace this water each at each feeding making it a good way to conduct small but ongoing water changes.

Pipette/baster method

Prepare food in a cup with seawater from the tank. Suck up the food using a pipette with a long nozzle, and gently spray the food at the underside (the side with oral arms) of each jellyfish. This method is probably the most practical as it does not waste too much food or water. It should be noted that some people report reduced feeding response from their jellyfish when target feeding regularly, if this is the case you should move to broadcast feeding until the jellyfish starts to respond again.

Broadcast feeding method

Prepare the correct amount of food for jellyfish in a cup, and slowly pour it evenly over the surface of the water. To avoid overfeeding, pour little by little until you see the stomachs of the jellyfish become full.

This method is the most convenient but it also has the potential to leave the largest amount of uneaten food which can result in more rapid degradation of water quality. If you use this method you will need to carry out larger more frequent water changes than the other two methods.

Water changes

We recommend carrying out a 10-20% water change every 2 weeks depending on your aquariums water quality. The frequency of water changes will depend largely on how heavily stocked your aquarium is, and how much you feed. Test the water regularly to ensure it stays within recommended ranges.

Prepare seawater at latest one day before doing a water change and leave it overnight with aeration. Some of the elements in sea salt take a long time (24h +) to fully dissolve, even if it looks like all the salt has disappeared newly mixed saltwater is very unstable and can cause stress to your jellyfish or in extreme cases death.

When you do a water change, stop the pump and other accessories such as heater or chiller. Prepare a bucket and hose (preferably with a long straight pipe attached to it so you can control the direction of suction). Start a siphon of water from your aquarium into the bucket. The speed of the siphon can be controlled by raising or lowering the bucked compared to the height of the water in your aquarium or by pinching the syphon tube. If the bucket is a lot lower than the water height in your aquarium the flow will be very fast which will increase the risk of sucking up jellies. Pinch the hose or hold the end of the hose if a jellyfish gets too close to the suction end to avoid it getting sucked up and damaged.
After you have siphoned 10-20% of seawater from the aquarium, add the prepared seawater to the tank slowly via the rear filter compartment which will limit the chances of any air bubbles getting to the jellies. Turn on the pump and other accessories. If air bubbles get trapped inside the bell of a jellyfish, use your hands to turn the jelly over and gently massage the bubbles free.

Cleaning

Over time, uneaten food and general debris may build up on the bottom of the aquarium and algae may begin to grow on the tank walls, especially in situations where the aquarium receives natural sunlight. Remove debris from the bottom of the tank using a baster, pipette or siphon hose being careful not to damage any jellies.

> **Warning**
> *Always use cleaning equipment designed specifically for use with acrylic. Scourers and other rough or sharp cleaning products will scratch acrylic. If in doubt about a cleaning product test on a small, none visible part of the tank first, such as the inside of the rear panel and check for scratches.*

Water flow

With the Cubic jellyfish aquarium, you can adjust the speed of water flow by rotating the dial attached to the suction side of the pump. The minimum pump speed setting should be sufficient to keep jellyfish in suspension, and this speed is optimal in most cases because the jellyfish move slowly which is relaxing to watch. You may however occasionally want faster flow to achieve special requirements or for different species of jellyfish.

Following is the list of advantages and disadvantages of having a faster flow:

Advantages

- Food stays in suspension for longer periods.
- Lighter debris stays in suspension and doesn't settle on the bottom
- Faster water turnover rate keeps water cleaner (occasionally it may be a good idea to increase the flow speed for a while after cleaning to filter out any suspended debris)
- Some jellyfish with strong swimming ability such as blue blubbers prefer strong flow to swim against

Disadvantages

- Increase the risk of jellyfish getting damaged by the suction areas especially in the case of weak swimmers such as moon jellyfish
- Food can be filtered out before the jellyfish has had a chance to catch it (more food waste)
- Less relaxing to look at as jellies move around the tank much quicker.

Husbandry for common jellyfish species

Moon jellyfish (Aurelia sp.)

Overview

Moon jellyfish are the most common jellyfish to find in local aquatic stores. Yet common, moon jellyfish are one of the most popular species because of their opaque white colour and the relaxing movement. This species is relatively easy to keep, and the Husbandry for this species is well established.

They usually come from cold to temperate waters and are bred commercially making them an ideal and environmentally friendly animal to keep, so it is recommended that you ask your dealer which strain of moon jellies they stock with preference shown towards more temperate strains. If cold water strains are kept, it will be necessary to have a chiller running on your aquarium. For temperate strains this may not be required under ambient room temperatures of up to 22-24^{o}C as the aquarium will usually attain an average temperature a few degrees below this level.

Distribution:	Throughout world's oceans, from cold to tropic, coastal area including estuaries and harbours.
Temperature:	15-25^{o}C depending on where they were collected or the strain cultured.
Feeding:	Live (enriched) baby brine shrimp, frozen baby brine shrimp, Ocean Nutrition Instant Baby Brine, frozen copepods, 1-2 times a day.
Life span:	1-2 years
Maximum size:	Bell diameter up to 40 cm (16 inches)
Flow speed:	Weak to medium
Harmful to human:	No
Photosynthetic:	No
Other notes:	Because of their bell shape, they can occasionally suck themselves against the walls or bottom of the aquarium, and may be unable to move away. When you see this, move them away gently by blowing water using a pipette or by wafting water across them. They can also catch air bubbles inside their bells. Avoid creating air bubbles as much as possible. When you see air bubbles caught under the bell, gently turn them upside down and massage the air free.

Blue blubber jellyfish (Catostylus mosaicus)

Overview:
Blue blubbers are also common species for jellyfish aquariums and relatively easy to keep. This species is distinguished by their dome shaped bell with eight oral arms which look like cauliflowers.

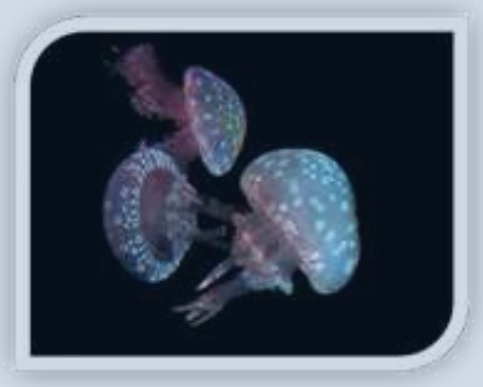
They are popular by their variety of colours from light blue to dark purple and burgundy. There are sometimes white and brown colour variants as well, which are thought to depend on the species of symbiotic algae living inside their body. They are strong and active swimmers.

Distribution:	East coast of Australia, Philippines
Temperature:	23-25^{o}C
Feeding:	Live (enriched) baby brine shrimp, frozen baby brine shrimp, Ocean Nutrition Instant Baby Brine, frozen copepods, 1-2 times a day
Life span:	2-3 months in captivity
Maximum size:	Bell diameter up to 35 cm (14 inches)
Flow speed:	Medium to strong
Harmful to human:	No
Photosynthetic:	Yes*
Other notes:	Even though they have symbiotic algae inside their body, the rate of photosynthesis contributing to their energy requirement is not great. Recently aquarists showed that they could be kept healthily by only feeding without full spectrum light. As they are strong swimmers, the top of their bells get easily damaged by hitting the bottom and walls of the aquarium. Keep the bottom and walls of your tank as smooth / clean as possible, and keep jellyfish away from bottom and walls by increasing flow speed.

Spotted jellyfish (Mastigias papua)

Overview

Spotted jellyfish (or lagoon jellyfish) inhabit quiet bays, harbours and lagoons of the South Pacific. They are easily distinguished by the white spots throughout their body and the eight appendages hanging down from oral arms.



They are very popular in aquarium trades for their variation of colour, which are pale blue, green, pink, orange and yellow, on their semi-translucent body covered with white spots. Instead of single mouth, they have many small mouth openings on their oral arms, which capture small zooplankton. As they depend on the photosynthesis by symbiotic algae for their energy requirements, full spectrum lighting is required in aquariums.

Distribution:	Indian Ocean, China Sea to Japan, and outward over the Pacific to the Fiji Islands
Temperature:	23-26^{o}C
Feeding:	Live (enriched) baby brine shrimp for 1-2 times a day, and full spectrum lighting for photosynthesis for 12 hours per day
Life span:	Up to 14 months
Maximum size:	Bell diameter of 14-16 cm (5.5 inches)
Flow speed:	Weak to medium
Harmful to human:	No
Photosynthetic:	Yes
Other notes:	

Upside down Jellyfish (Cassiopea sp.)

Overview

The upside down jellyfish is so called because it spends most of its time on mudflats with its bell against the sea bed and its tentacles pointed towards the water surface. This jellyfish is one of the easiest species to keep as it does not require a kreisel system.

They could even be kept in plastic bottles when they are small. The variation in their colour is one of their attractions, such as blue, green, orange and brown, usually with white stripes on their bells. Even though they are photosynthetic, they still require to be fed baby brine shrimp regularly to grow healthily.

Distribution:	Upside down jellyfish are commonly found in mangrove swamps and mad flats in tropical waters over the world, such as Caribbean Sea, West Atlantic Sea, Indo-Pacific, Gulf of Mexico and South of Japan.
Temperature:	23-26^{o}C
Feeding:	Live (enriched) baby brine shrimp 1-2 times a day, and full spectrum lighting for photosynthesis for 12 hours per day
Life span:	Up to 5 years
Maximum size:	30 – 35 cm (12-14 inches)
Flow speed:	weak to medium
Harmful to human:	People with sensitive skin can come out in a red rash-like skin irritation
Photosynthetic:	Yes
Other notes:	Upside down jellyfish can be kept in normal fish tanks with ambient sunlight. Avoid direct sunlight by shading the aquarium, and be careful of increasing temperatures (in excess of 28^{o}C). They can look very similar to the '*Hellsfire*' sea anemone which has a very strong poison (Phyllodiscussemoni). Please do not touch them in the sea unless you are absolutely sure that they are upside down jellyfish.

Comb jellyfish (Ctenophore)

Overview
Common species for comb jellyfish are Cydipidda (sea gooseberries), Lobata and Beroida.

They are not common for aquarium market but their delicate beauty continues to fascinate people around the world. Species in Cydipidda and Lobata are fed with live baby brine shrimp, and Beroida needs to be fed with other ctenophore jellyfish. Their fragile body makes keeping them in captivity hard. They could be kept in captivity for at most 3 months in a kreisel system with good care.

Distribution:	Not enough research is available to describe the distribution of comb jellyfish. They seem to inhabit all oceanic environments from tropical to cold, coastal to pelagic, and shallow to deep water. Many unfound species of comb jellyfish are thought to inhabit the deep oceans.
Temperature:	15-20^{o}C
Feeding:	Live baby brine shrimp for Cydipidda and Lobata species (1-2 times a day), and live comb jellyfish for Beroida species (once every few days).
Life span:	Up to 3 months
Maximum size:	
Flow speed:	Weak to medium
Harmful to human:	No
Photosynthetic:	No
Other notes:	There is no aquarium trade for comb jellyfish at the moment. However, they are commonly found in coastal waters. Throw a plankton net with a cod-end attached from a jetty near you, and you might be lucky enough to catch some. Try and enjoy keeping comb jellyfish, and immerse yourself into the mystical world of comb jellyfish.

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